

REMARKS

In the Office Action dated March 3, 2011, the Examiner indicated that Applicants reply of August 30, 2010 is considered non-compliant because it has failed to meet the requirements of 37 C.F.R. § 1.121. Applicants submit herewith a revised amendment in compliance with 37 C.F.R. § 1.121. No new matter has been added.

The Final Office Action dated March 30, 2010 and Advisory Action dated July 9, 2010 have been carefully considered. Claim 1 has been amended. Claims 3, 5, 6 and 9 have been canceled. Claims 1, 2, 4, 7 and 8 are in this application.

Support for the amendment to claim 1 is found throughout the specification and in particular in original claims 5 and 9, examples 5 and 6 and Figs. 6 and 7. No new matter has been entered.

Claims 1-4, 6, 8 and 9 are rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent Application Publication No. 2001/0033971 to Zhao et al. and evidenced by U.S. Patent Application Publication No. 2010/0047161 to Latturmer et al.

Claim 1 is amended to include the limitation of a solvent from original claim 5 and a sulfur compound of the positive electrode from original claim 9. The solvent is not disclosed in Zhao et al. and the liquid electrolyte of claim 1 is different from the electrolyte of Zhao et al. in its structure. Accordingly, each of the limitations of the present claims is not taught or suggested in Zhao et al. and the invention defined by the present claims is not anticipated.

Claim 5 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhao et al. as evidenced by Latturmer et al. as applied to claims 1-4, 6, 8 and 9 above, and further in view of newly cited U.S. Patent Application Publication No. 2003/0219647 to Wariishi.

Zhao et al. disclose that the positive electrode contains carbon and sulfur. However, the CS compound recited in Zhao et al. is a compound that contains C and S, which is different in its chemical and physical properties from sulfur compound of the positive electrode of present claim 1 selected from NiS, FeS₂ and PbS. Applicants submit that the positive electrode of claim 1 of the present invention comprises a sulfur compound selected from NiS, FeS₂ and PbS, whereas the positive electrode of Zhao et al. is a CS electrode. As described in paragraph [0003] of Zhao et al., the sulfur electrode has an energy density as high as 1675 mAh/g theoretically, but

sulfur is highly insulating and poor in reversibility. Therefore, it is difficult to use the CS compound for an electrode. However, the present invention overcomes this problem and provides a Na/S battery having an excellent electrostatic capacity by using a sulfur compound for the positive electrode. To achieve this, the present invention uses an electrolyte having a specific solvent and uses a sulfur compound for a positive electrode, as recited in amended claim 1.

Referring to Fig. 6 and 7 of the present application, the Na/S battery recited in claim 1 of the present invention has a discharging capacity of at least 100mAh/g based on the mass of sulfur compound and a discharging voltage ranged of the battery is between 0.1V and 2.4V. However, Zhao et al. do not disclose or suggest any detailed experiment or properties relating to the Na/CS battery.

Referring to Fig. 7, Zhao et al. merely mention a Li/CSn+NiS battery. However, the Li/CSn+NiS battery defined in Zhao et al. is different from the Na/S battery defined in amended claim 1 of the present invention.

Applicants submit that even though Zhao et al. disclose that sodium can be used for a negative electrode in paragraph [0059], Zhao et al. do not teach or suggest an experiment in which the sodium is actually used. Also, the Li/CSn+NiS battery experimented in Zhao et al. has a negative electrode of Li, which is different from Na in its flat voltage.

As described above, CS and the claimed sulfur compound are different materials and thus it is difficult for one of ordinary skill in the art to derive the battery of the present invention from the teachings of CS disclosed in Zhao et al.

Also, Zhao et al. do not disclose an embodiment in which a battery is manufactured with a sodium electrode along with a (CS_x)_n electrode and thus, one of ordinary skill in the art would not know from Zhao et al. whether a battery could be manufactured with a sodium electrode. Although discharge capacities when CS_x/n is used for a positive electrode and lithium is used for a negative electrode are shown in Table 1 of Zhao et al., they are much lower than in a battery manufactured with lithium and sulfur electrodes.

Also, in Zhao et al., alkali metals such as lithium and sodium may be used for a negative electrode (see paragraph [0059]) and the negative electrode may be manufactured in the form of a porous metal body (see paragraph [0060]). However, these teachings do not teach or suggest

that the negative electrode including sodium can be manufactured in a solid state. Applicants submit that a metal negative battery such as a lithium battery using solid lithium and operating under high temperature and a lead battery using solid lead and operating under high temperature was generally known in the related art prior to filing of this application. A sodium battery using liquid sodium and operating over 300°C was also known in the related art prior to filing of this application. However, there is no teaching or suggestion of a battery using a solid-type sodium negative electrode and Zhao et al. also do not clearly teach using the solid-type sodium negative electrode, as recited in amended claim 1.

Further, the Examiner states that Wariishi discloses liquid electrolytes similar some of solvents of the electrolyte recited in claim 1 of the present invention. However, Wariishi does not teach or suggest the liquid electrolytes of the present claims. And also, Wariishi fails to teach the Na/S battery as recited in claim 1 of the present invention and does not cure the deficiencies of Zhao et al. noted above. Moreover, since the positive electrode of Zhao et al. is different from the positive electrode of the present invention, the combination of Zhao et al. and Wariishi does not teach or suggest the invention defined by the present claims and the invention defined by the present claims is not obvious in view of Zhao et al. as evidenced by Lattuner et al. in combination with Wariishi.

Claim 7 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Zhao et al. as evidenced by Lattuner et al. as applied to claims 1-4, 6, 8 and 9 above, and further in view of newly cited U.S. Patent Application Publication No. 2002/0037457 to Choi.

Choi discloses a lithium battery including a lithium negative electrode, a positive electrode comprising an electrically conductive material and a binder. However, Choi does not teach or suggest the Na/S battery and the liquid electrolytes of the present claims and does not cure the deficiencies of Zhao et al. noted above. Accordingly, the invention defined by the present claims is not obvious in view of Zhao et al. as evidenced by Lattuner et al. and further in view of Choi.

In view of the foregoing, Applicants submit that all pending claims are in condition for allowance and request that all claims be allowed. The Examiner is invited to contact the

undersigned should she believe that this would expedite prosecution of this application. It is believed that no fee is required. The Commissioner is authorized to charge any deficiency or credit any overpayment to Deposit Account No. 13-2165.

Respectfully submitted,



Dated: March 28, 2011

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